User's Manual

FA-M3 V VITESSE™

Sequence CPU - Modbus/TCP Functions

IM 34M06P15-03E

vigilantplant.®

Applicable Modules:

Model Code	Model Name
F3SP71-4S	Sequence CPU Module (with network functions)
F3SP76-7S	Sequence CPU Module (with network functions)

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Applicable Product

● Range-free Multi-controller FA-M3

Model code	Name
F3SP71-4S	Sequence CPU Module (with network functions)
F3SP76-7S	Sequence CPU Module (with network functions)

The document number and document model code for this manual are given below.

Refer to the document number in all communications, including when purchasing additional copies of this manual.

Document No.	:	IM 34M06P15-03E
Document Model Code	:	DOCIM

Media No. IM 34M06P15-03E (CD) 2nd Edition : Jan. 31, 2012 (YHQ)
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Important

■ About This Manual

- This Manual should be passed on to the end user.
- Before using the controller, read this manual thoroughly to have a clear understanding of the controller.
- This manual explains the functions of this product, but there is no guarantee that they will suit the particular purpose of the user.
- Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.
- The contents of this manual are subject to change without prior notice.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.

■ Safety Precautions when Using/Maintaining the Product

- The following safety symbols are used on the product as well as in this manual.

Danger. This symbol on the product indicates that the operator must follow the instructions laid out in this user's manual to avoid the risk of personnel injuries, fatalities, or damage to the instrument. Where indicated by this symbol, the manual describes what special care the operator must exercise to prevent electrical shock or other dangers that may result in injury or the loss of life.

Protective Ground Terminal. Before using the instrument, be sure to ground this terminal.

Function Ground Terminal. Before using the instrument, be sure to ground this terminal.

Alternating current. Indicates alternating current.

Direct current. Indicates direct current.

The following symbols are used only in the user's manual.

WARNING

Indicates a "Warning".
Draws attention to information essential to prevent hardware damage, software damage or system failure.

CAUTION

Indicates a "Caution"
Draws attention to information essential to the understanding of operation and functions.

TIP

Indicates a "TIP"
Gives information that complements the present topic.

SEE ALSO

Indicates a "SEE ALSO" reference.
Identifies a source to which to refer.

- For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety stated in this manual whenever handling the product. Take special note that if you handle the product in a manner other than prescribed in these instructions, the protection feature of the product may be damaged or impaired. In such cases, Yokogawa cannot guarantee the quality, performance, function and safety of the product.
- When installing protection and/or safety circuits such as lightning protection devices and equipment for the product and control system as well as designing or installing separate protection and/or safety circuits for fool-proof design and fail-safe design of processes and lines using the product and the system controlled by it, the user should implement it using devices and equipment, additional to this product.
- If component parts or consumable are to be replaced, be sure to use parts specified by the company.
- This product is not designed or manufactured to be used in critical applications which directly affect or threaten human lives and safety — such as nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, shipboard equipment, aviation facilities or medical equipment. If so used, it is the user's responsibility to include in the system additional equipment and devices that ensure personnel safety.
- Do not attempt to modify the product.

■ Exemption from Responsibility

- Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa Electric) makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
- Yokogawa Electric assumes no liability to any party for any loss or damage, direct or indirect, caused by the use or any unpredictable defect of the product.

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- Yokogawa Electric makes no other warranties expressed or implied except as provided in its warranty clause for software supplied by the company.
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■ General Requirements for Using the FA-M3 Controller

● Avoid installing the FA-M3 controller in the following locations:

- Where the instrument will be exposed to direct sunlight, or where the operating temperature exceeds the range 0°C to 55°C (32°F to 131°F).
- Where the relative humidity is outside the range 10 to 90%, or where sudden temperature changes may occur and cause condensation.
- Where corrosive or flammable gases are present.
- Where the instrument will be exposed to direct mechanical vibration or shock.
- Where the instrument may be exposed to extreme levels of radioactivity.

● Use the correct types of wire for external wiring:

- Use copper wire with temperature ratings greater than 75°C.

● Securely tighten screws:

- Securely tighten module mounting screws and terminal screws to avoid problems such as faulty operation.
- Tighten terminal block screws with the correct tightening torque as given in this manual.

● Securely lock connecting cables:

- Securely lock the connectors of cables, and check them thoroughly before turning on the power.

● Interlock with emergency-stop circuitry using external relays:

- Equipment incorporating the FA-M3 controller must be furnished with emergency-stop circuitry that uses external relays. This circuitry should be set up to interlock correctly with controller status (stop/run).

● Ground for low impedance:

- For safety reasons, connect the [FG] grounding terminal to a Japanese Industrial Standards (JIS) Class D (earlier called Class 3) Ground[*1]. For compliance to CE Marking, use braided or other wires that can ensure low impedance even at high frequencies for grounding.

*1 Japanese Industrial Standard (JIS) Class D Ground means grounding resistance of 100 Ω max.

● Configure and route cables with noise control considerations:

- Perform installation and wiring that segregates system parts that may likely become noise sources and system parts that are susceptible to noise. Segregation can be achieved by measures such as segregating by distance, installing a filter or segregating the grounding system.

● Configure for CE Marking Conformance:

- For compliance to CE Marking, perform installation and cable routing according to the description on compliance to CE Marking in the “Hardware Manual” (IM 34M06C11-01E).

- **Keep spare parts on hand:**
  - We recommend that you stock up on maintenance parts including spare modules.
  - Preventive maintenance (replacement of the module or its battery) is required for using the module beyond 10 years. For enquiries on battery replacement service (for purchase), contact your nearest Yokogawa Electric representative or sales office. (The module has a built-in lithium battery. Lithium batteries may exhibit decreased voltage, and in rare cases, leakage problems after 10 years.)

- **Discharge static electricity before operating the system:**
  - Because static charge can accumulate in dry conditions, first touch grounded metal to discharge any static electricity before touching the system.

- **Never use solvents such as paint thinner for cleaning:**
  - Gently clean the surfaces of the FA-M3 controller with a cloth that has been soaked in water or a neutral detergent and wringed.
  - Do not use volatile solvents such as benzine or paint thinner or chemicals for cleaning, as they may cause deformity, discoloration, or malfunctioning.

- **Avoid storing the FA-M3 controller in places with high temperature or humidity:**
  - Since the CPU module has a built-in battery, avoid storage in places with high temperature or humidity.
  - Since the service life of the battery is drastically reduced by exposure to high temperatures, take special care (storage temperature should be from -20°C to 75°C).
  - There is a built-in lithium battery in a CPU module and temperature control module which serves as backup power supply for programs, device information and configuration information. The service life of this battery is more than 10 years in standby mode at room temperature. Take note that the service life of the battery may be shortened when installed or stored at locations of extreme low or high temperatures. Therefore, we recommend that modules with built-in batteries be stored at room temperature.

- **Always turn off the power before installing or removing modules:**
  - Failing to turn off the power supply when installing or removing modules, may result in damage.

- **Do not touch components in the module:**
  - In some modules you can remove the right-side cover and install ROM packs or change switch settings. While doing this, do not touch any components on the printed-circuit board, otherwise components may be damaged and modules may fail to work.

- **Do not use unused terminals:**
  - Do not connect wires to unused terminals on a terminal block or in a connector. Doing so may adversely affect the functions of the module.

■ Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC
(This directive is only valid in the EU.)

This product complies with the WEEE Directive (2002/96/EC) marking requirement. The following marking indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category
With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.
Do not dispose in domestic household waste.
When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

■ How to Discard Batteries

The following description on DIRECTIVE 2006/66/EC (hereinafter referred to as the EU new directive on batteries) is valid only in the European Union.

Some models of this product contain batteries that cannot be removed by the user. Make sure to dispose of the batteries along with the product.

Do not dispose in domestic household waste.
When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

Battery type: Lithium battery

Note: The symbol above means that the battery must be collected separately as specified in Annex II of the EU new directive on batteries.

Introduction

■ Overview of the Manual

This manual explains the commands and responses for communication control with higher-order computers via Modbus/TCP and with the sequence CPU module used with the FA-M3 (F3SP71-4S, F3SP76-7S).

■ Related User's Manuals

Depending on the type of the CPU module, you should refer to different user's manuals.

F3SP71
F3SP76

● About functions

- Sequence CPU Instruction Manual - Functions (for F3SP71-4N/4S, F3SP76-7N/7S) (IM 34M06P15-01E)
- Sequence CPU - Network Functions (for F3SP71-4N/4S, F3SP76-7N/7S) (IM 34M06P15-02E)

● To create ladder programs

- FA-M3 Programming Tool WideField3 (IM 34M06Q16-☐☐E)

Refer to the following manuals, if required.

● For FA-M3 specifications and configuration*1, installation and wiring, test run, maintenance and inspection or system-wide restrictions on module installation

*1: For specification of products other than the power supply module, base module, input/output module, cable, and terminal unit, refer to the respective product manuals.

- Hardware Manual (IM 34M06C11-01E)

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FA-M3
Sequence CPU - Modbus/TCP Functions

IM 34M06P15-03E 2nd Edition

CONTENTS

Applicable Product i
Important ii
Introduction viii
Copyrights and Trademarks ix
1. Overview 1-1
1.1 Overview of Modbus/TCP Slave Function 1-1
1.2 System Configuration of Modbus/TCP Slave Function 1-2
2. Modbus/TCP Slave Function 2-1
2.1 Specifications 2-1
■Functional Specifications 2-1
■Communication Functions 2-1
2.2 Communication Protocol 2-1
2.3 Data Frames 2-2
2.4 Function Codes 2-3
■Support Function Codes 2-3
■PDU Configuration 2-4
2.5 Response Error Code 2-5
2.6 Modbus Device Allocation Specifications 2-6
■Modbus Device List 2-6
■Modbus Device Associations 2-7
2.7 Specifying Devices in Commands 2-12
■List of Supported Devices 2-12
2.8 Modbus/TCP Slave Function Settings 2-13
■Required Settings 2-13
■Settings Specified as Necessary 2-14
2.9 Using Modbus/TCP Slave Function via Ethernet 2-15
■Connecting to a Monitor 2-15
■Connecting to a PC 2-15
3. Command/Response Details 3-1
3.1 Read Coils ($01) 3-1
3.2 Read Discrete Inputs ($02) 3-2
3.3 Read Holding Registers ($03) 3-3

3.4 Read Input Registers ($04) 3-4
3.5 Write Single Coil ($05) 3-5
3.6 Write Single Register ($06) 3-6
3.7 Write Multiple Coils ($0F) 3-7
3.8 Write Multiple Registers ($10) 3-8
3.9 Read File Record ($14) 3-9
3.10 Write File Record ($15) 3-11
3.11 Mask Write Register ($16) 3-13
3.12 Read/Write Multiple Registers ($17) 3-14
3.13 Read FIFO Queue ($18) 3-15

Revision Information i

1. Overview

This manual describes only the Modbus/TCP server (slave) function (hereinafter referred to as "Modbus/TCP slave function").

CAUTION

F3SP7☐-☐S does not have the Modbus/TCP client (master) function.

1.1 Overview of Modbus/TCP Slave Function

The Modbus/TCP slave function is for connecting FA-M3 to a Modbus network. It enables Modbus communication to receive process requests from a master device via Ethernet lines under Modbus commands. As no programming is required on the module end, this greatly simplifies creation of SCADA applications on the monitor or PC.

In this module, the Modbus/TCP slave function can be used via the 10BASE-T /100BASE-TX connector located on its front panel.

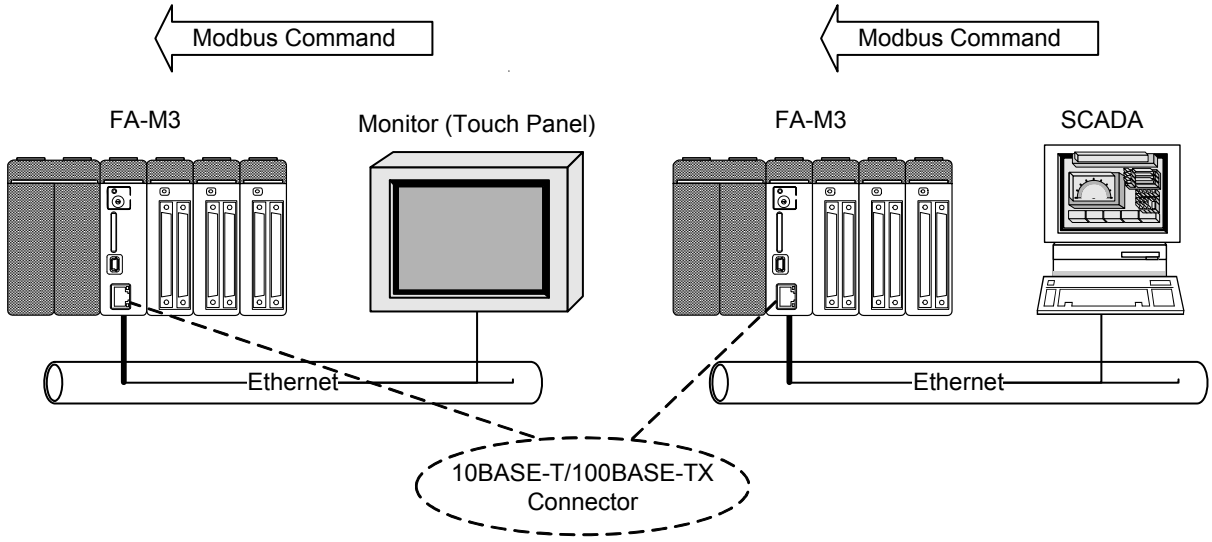


Figure 1.1.1 Example Configuration of Modbus/TCP Slave Function

1.2 System Configuration of Modbus/TCP Slave Function

This section describes the system configuration of the Modbus/TCP slave function.

● Configuration via Ethernet

In this system configuration, connection is via the 10BASE-T/100BASE-TX connector located on the front panel of the module. A monitor or PC is connected using Modbus/TCP application protocol.

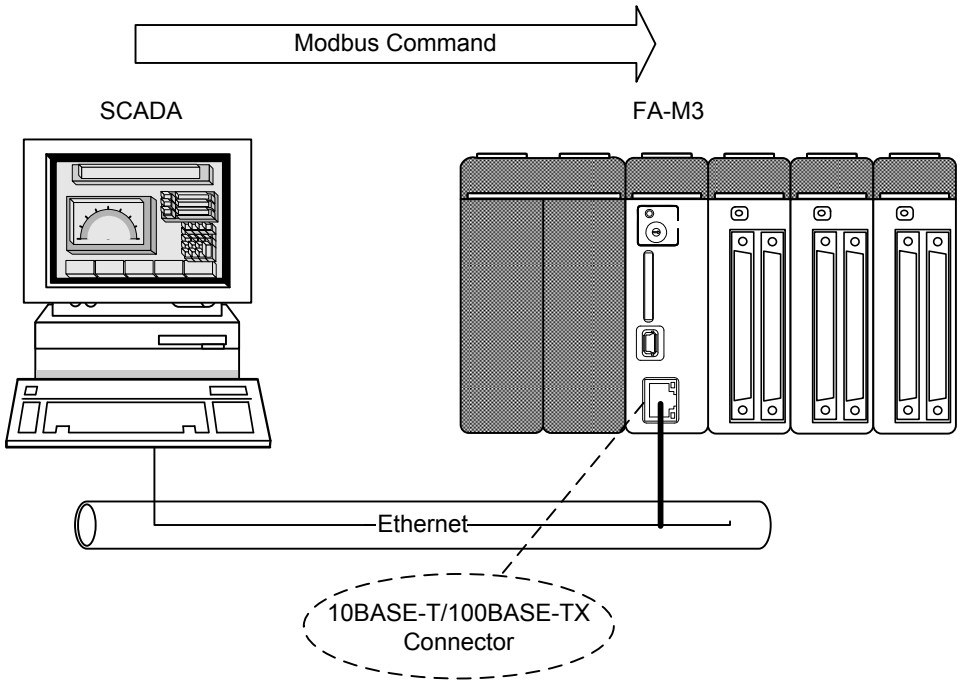


Figure 1.2.1 Example Configuration of Modbus/TCP Slave Function via Ethernet

Table 1.2.1 Supported Modbus Slave Functions

Function	Description	Support
Serial communication	Modbus communication via Serial communication	No
Ethernet communication	Modbus communication via Ethernet	Yes
Write-protect function	Function that prohibits device writing using Modbus commands.	Yes

2. Modbus/TCP Slave Function

This chapter describes the Modbus/TCP slave function via Ethernet.

2.1 Specifications

This section describes the functional and communication specifications of the Modbus/TCP slave function.

■ Functional Specifications

The following table shows the functional specifications of the Modbus/TCP slave function.

Table 2.1.1 Supported Modbus Slave Functions

Function	Description	Support
Serial communication	Modbus communication via Serial communication	No
Ethernet communication	Modbus communication via Ethernet	Yes
Write-protect function	Function that prohibits device writing using Modbus commands.	Yes

■ Communication Functions

The following table shows the communication specifications of the Modbus/TCP slave function.

Table 2.1.2 Specifications of Higher-level Link Service Provided by Modbus/TCP Slave Function (Ethernet)

Specification Item	Specification
Communications protocol	TCP/IP
Maximum number of connections	8 (Total amount of TCP/IP connections of higher-level link services)
Port number	502 ($01F6)
Command data format	Binary

2.2 Communication Protocol

In Modbus/TCP frame, the module returns one response to each request received from a higher-level computer (monitor or PC).

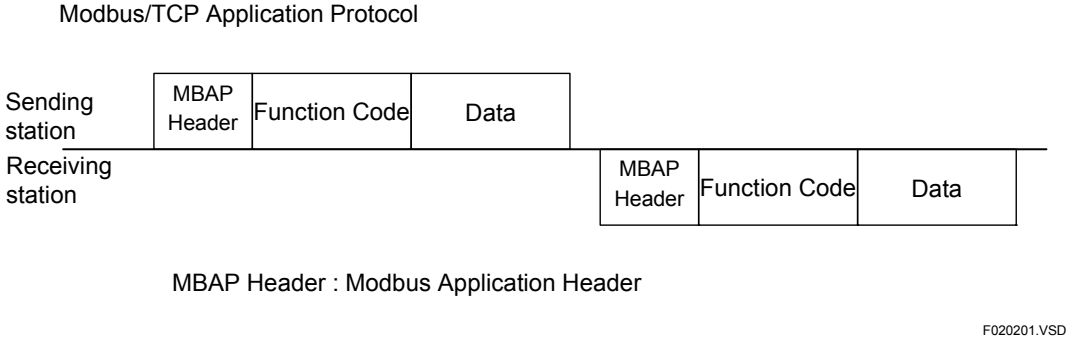


Figure 2.2.1 Communication Protocol

2.3 Data Frames

The specifications of the Modbus/TCP data frames are as shown below.

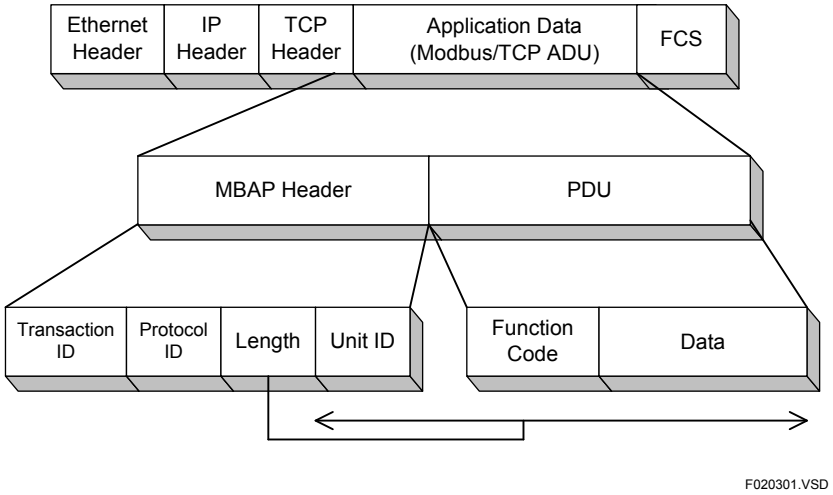


Figure 2.3.1 Modbus/TCP Data Frames

● MBAP Header

The Modbus Application Protocol (MBAP) header consists of seven bytes.

Table 2.3.1 MBAP Header

Name	Size	Description
Transaction ID	2-byte	Freely selected value is specified to identify transactions of the master device. The slave returns the received value.
Protocol ID	2-byte	"0" is specified if using the Modbus/TCP application protocol.
Length	2-byte	Byte count from after the unit ID.
Unit ID	1-byte	Used by the master when specifying the slave connected to another line via a gateway or similar method. Specifies the CPU number (1 to 4) executing commands.*1 The slave returns the received value.

*1: The CPUs that can be specified are the sequence CPU F3SP22/28/38/53/58/59/66/67/71/76. It cannot be executed for other CPUs.

Tip

"1" is specified for the unit ID if the access target is the CPU inserted into slot 1.

"2" is specified for the unit ID if the access target is the CPU inserted into slot 2 with the CPU connected using Modbus/TCP is inserted in slot 1.

● PDU

The Protocol Data Unit (PDU) is configured as follows.

Table 2.3.2 PDU

Name	Size	Description
Function code	1-byte	Processing contents for the slave from the master.
Data	1 to 252 bytes	Parameters for the function code.

2.4 Function Codes

This section describes the Modbus function codes.

■ Support Function Codes

The functions codes supported by this module are as shown below.

Table 2.4.1 Function Code List

Function Code	Name	Description	Supported
01 ($01)	Read Coils	Consecutively reads the status of a max. of 2,000 coils.	Yes
02 ($02)	Read Discrete Inputs	Consecutively reads the status of a max. of 2,000 inputs.	Yes
03 ($03)	Read Holding Registers	Consecutively reads the status of a max. of 125 holding registers.	Yes
04 ($04)	Read Input Registers	Consecutively reads the status of a max. of 125 input registers.	Yes
05 ($05)	Write Single Coil	Writes a single coil.	Yes
06 ($06)	Write Single Register	Writes a single register.	Yes
15 ($0F)	Write Multiple Coils	Consecutively writes the status of a max. of 1,968 coils.	Yes
16 ($10)	Write Multiple Registers	Consecutively writes the status of a max. of 123 registers.	Yes
20 ($14)	Read File Record	Reads a max. of 124 file records.	Yes
21 ($15)	Write File Record	Writes a max. of 122 file records.	Yes
22 ($16)	Mask Write Register	Mask a single register with AND or OR.	Yes
23 ($17)	Read/Write Multiple Registers	Reads and writes multiple registers.	Yes
24 ($18)	Read FIFO Queue	Reads FIFO tables.	Yes

■ PDU Configuration

This subsection describes the configuration of function codes and data.

● Specifying Device Numbers in PDU

"(Device number) - 1" is specified in the PDU for setting a device number.

The above does not apply to file and record numbers specified at Read/Write File Record command.

Example: If the status of holding register no. 32 is single-word read at Read Holding Registers ($03).

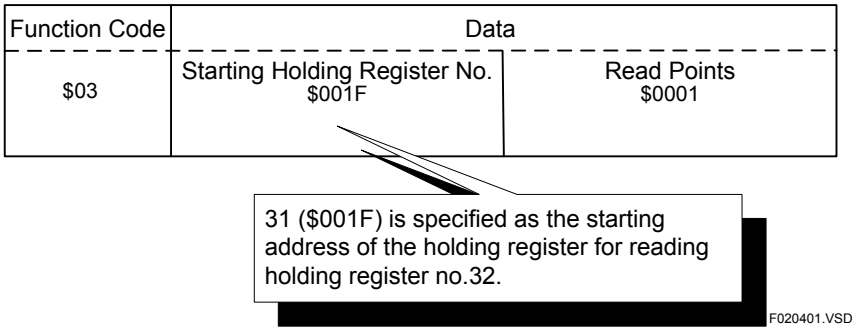


Figure 2.4.1 Specifying Device Numbers

Device numbers stored in responses are request command device numbers.

Tip

$0000 is used in the PDU for specifying the starting coil number 00001 corresponding to I0001.

● How to Read the Format

This subsection explains how to read the request/response format block diagram.

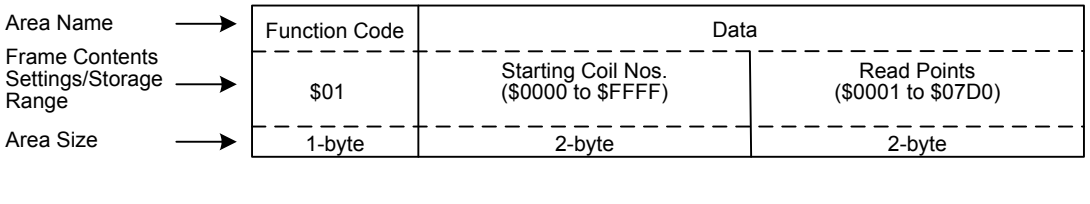


Figure 2.4.2 How to Read Format

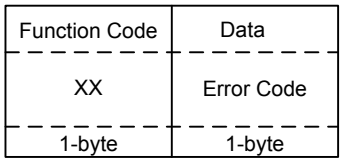
2.5 Response Error Code

This section describes the response error codes.

● If Error Response is Returned

This module returns a response as shown below if there is a mismatch in the PDU during a request or an error during processing.

(PDU at Faulty Completion)



F020501.VSD

Figure 2.5.1 PDU at Faulty Completion

The request function code +$80 value is inserted in the function code (XX).

● Response Error Code

Table 2.5.1 Response Error Code

Error Code	Meaning	Cause
$01	Function Code Error	There is no function code.
$02	Address Error	Out-of-range address was specified.
$03	Amount Error	Out-of-range amount was specified.
$04	Processing Error	Write protect is specified.
$0A	CPU Number Error	Unit ID that is not from 1 to 4 was specified.
$0B	Timeout	CPU specified by the unit ID does not exist.

2.6 Modbus Device Allocation Specifications

This section describes the associations between the Modbus device and the devices of this module.

■ Modbus Device List

Modbus devices are as defined below. Devices are as described below.

Table 2.6.1 Modbus Device List

Modbus Device	Unit/Direction	Points	Number
Coil	1-bit/Read, Write	65,536	1 to 65536
Discrete input	1-bit/Read	65,536	1 to 65536
Input register	16-bit/Read	65,536	1 to 65536
Holding register	16-bit/Read, Write	65,536	1 to 65536
File record	16-bit/Read, Write	655,360,000	File: 0 to 65535 Record: 0 to 9999

■ Modbus Device Associations

This subsection describes the associations between the Modbus device and the devices of this module.

● Coil

Coils are associated with internal relays (I).

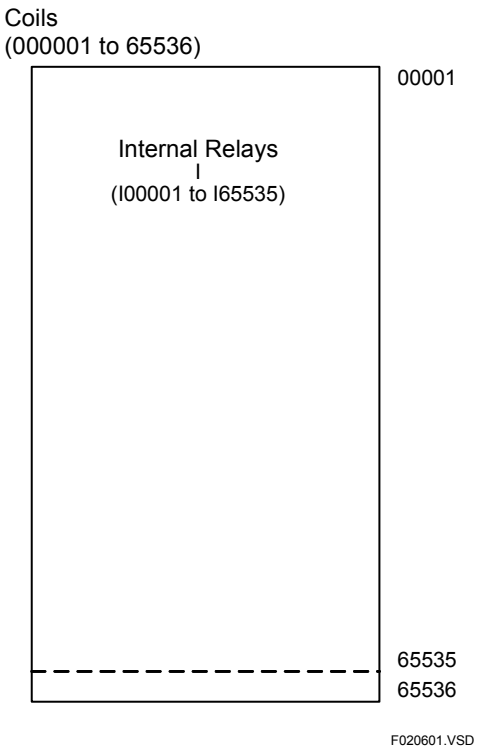


Figure 2.6.1 Associations of Coil/Internal Relay

I00001 is associated with 00001 of the coils.

The coil device number associated with an internal relay is calculated using the following formula.

Coil device number = Internal relay number

The maximum amount of access points depends on the allocation points of the internal relays.

Tip

$0000 is used in the PDU for specifying the starting coil number 00001 corresponding to I0001.

Discrete Inputs

Discrete inputs are associated with input relays (X) and special relays (M).

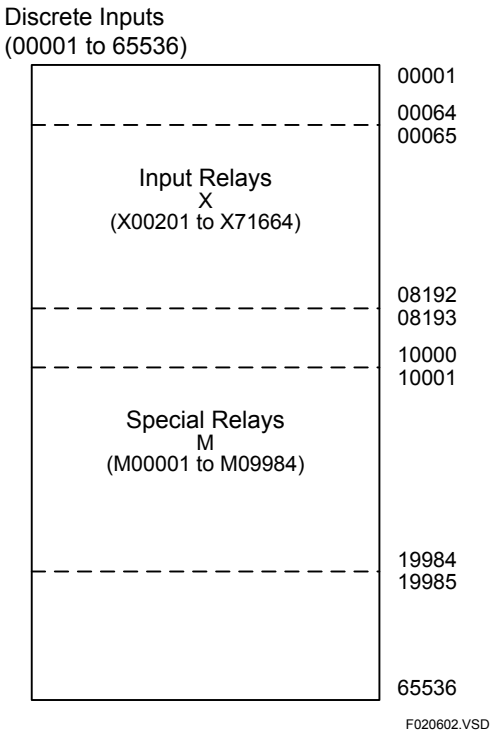


Figure 2.6.2 Associations of Discrete Inputs with Internal Relays (X) and Special Relays (M)

X00201 is associated with input 00065.

The input device number associated with an input relay is calculated using the following formula.

Input device number = Unit number x 1024
+ (Slot number - 1) x 64
+ Terminal number

M00001 is associated with input 10001.

The input device number associated with a special relay is calculated using the following formula.

Input device number = Special relay number + 10000

Tip

$0040 is used in the PDU for specifying the input number 00065 corresponding to X00201.

$2710 is used in the PDU for specifying the input number 10001 corresponding to M0001.

●Input Register

Special registers (Z) are associated with input registers.

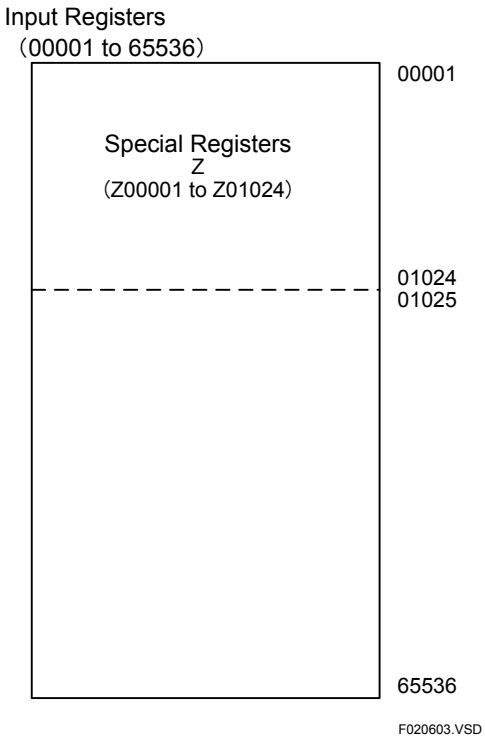


Figure 2.6.3 Associations of Input Registers with Special Registers (Z)

Z00001 is associated with 00001 of the input registers.

The input register device number associated with a special register is calculated using the following formula.

Input register device number = Special register number

Tip

$0000 is used in the PDU for specifying the input register number 00001 corresponding to Z00001.

Holding Register

Holding registers are associated with data registers (D).

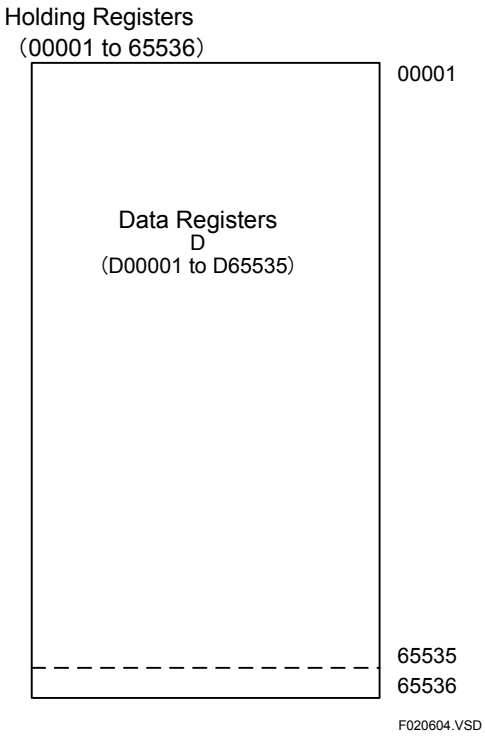


Figure 2.6.4 Associations of Holding Registers and Data Registers (D)

D00001 is associated with 00001 of the holding registers.

The holding register device number associated with a data register is calculated using the following formula.

Holding register device number = Data register number

The maximum amount of access points depends on the allocation points of the data registers.

Tip

$0000 is used in the PDU for specifying the starting holding register number 00001 corresponding to D00001.

File Record

File records are associated with file registers (B) and cache registers (F).

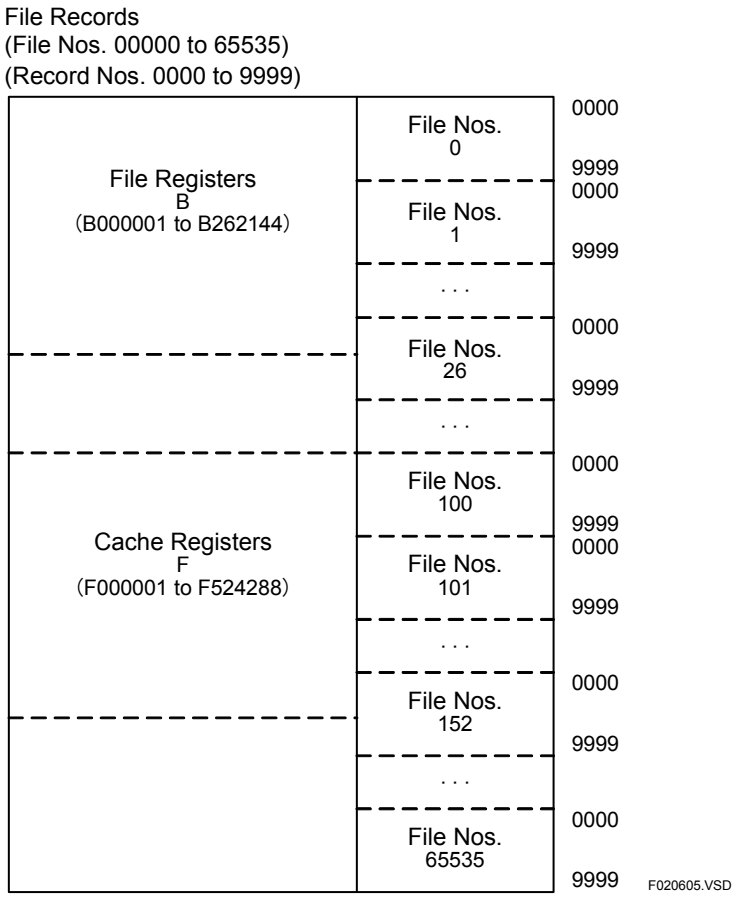


Figure 2.6.5 Associations of File Records

B00001 is associated with record number 0000 of file number 0.

The file and record numbers associated with file registers are calculated using the following formula.

File number = File register number / 10000

Record number = File register number % 10000 - 1

The maximum amount of access points depends on the allocation points of the file registers.

F00001 is connected with record code number 0000 of file number 100.

The file and record numbers associated with cache registers are calculated using the following formula.

File number = Cache register number / 10000 + 100

File number = Cache register number % 10000 - 1

The maximum amount of access points depends on the allocation points of the file registers.

2.7 Specifying Devices in Commands

This section describes how to address a device of a sequence CPU module in a command.

■ List of Supported Devices

The table below lists the devices of a sequence CPU module that are accessible using commands.

Table 2.7.1 List of Supported Devices

Device		Function	
		Name	Code
Bit Device	Input Relay	Read Discrete Input	02
	Output Relay	–	–
	Internal Relay	Read Coils	01
		Write Single Coil	05
		Write Multiple Coils	15
	Shared Relay	–	–
	Special Relay	Read Discrete Input	02
	Timer Relay	–	–
	Counter Relay	–	–
	Link Relay	–	–
Word Device	Data Register	Read Holding Register	03
		Write Single Register	06
		Write Multiple Registers	16
		Read/Write Multiple Registers	23
		Mask Write Register	22
		Read FIFO queue	24
	File Register	Read File Record	20
		Write File Record	21
	Cache Register*1	Read File Record	20
		Write File Record	21
	Shared Register	–	–
	Index Register	–	–
	Special register	Read Input Register	04
	Link Register	–	–
	Timer Set Value	–	–
	Timer Current Value	–	–
	Timer Current Value (Count-up type)	–	–
	Counter Set Value	–	–
	Counter Current Value	–	–
	Counter Current Value (Count-up type)	–	–

- : Access is not available.

2.8 Modbus/TCP Slave Function Settings

This section describes the settings for using the Modbus/TCP slave function.

■Required Settings

Settings required for using the Modbus/TCP slave function via Ethernet are as shown below.

Table 2.8.1 Required Settings (Modbus/TCP Slave Function via Ethernet)

Setting Name	Setting Type	Reference for Details*1
Ethernet Settings	CPU Properties	A9.5.2 Ethernet Setup
Higher-Level Link Service Settings	CPU Properties	A9.5.4 Higher-level Link Service Setup

*1: Refer to items of "Sequence CPU Instruction Manual - Functions (for F3SP71-4N/4S, F3SP76-7N/7S)" (IM 34M06P15-01E).

● Ethernet Settings

Settings are specified in order to connect to an Ethernet network. At a minimum, IP address and subnet mask settings are required. If 0.0.0.0 is specified for the subnet mask, a default mask corresponding to the IP address class is used.

● Higher-Level Link Service Settings

Specify "2" for the port A or B protocol setting in order to use the Modbus/TCP slave function. At this time, that port executes the Modbus/TCP slave function at port number 502 and the value of the command data format is ignored.

Additionally, enable the write-protect function (writing not permitted) if you want to prohibit device writing using the Modbus/TCP slave function.

Table 2.8.2 Higher-Level Link Service Settings

Setting	Description	Setting Range	Initial Value
Higher-Level Link Service: Port A Protocol	For selecting the protocol used by port A of the higher-level link service of the Ethernet route. Port number of port A is 12289 ($3001) if TCP/IP or UDP/IP is selected, and port number is 502 ($1F6) if Modbus/TCP (slave) is selected.	0 = TCP/IP 1 = UDP/IP 2 = Modbus/TCP (Slave)	0（TCP/IP）
Higher-Level Link Service: Port A Command Data Format	For selecting the command data format used by port A of the higher-level link service of the Ethernet route. Ignored if Modbus/TCP (slave).	0 = ASCII format 1 = Binary format	0 (ASCII format)
Higher-Level Link Service: Port B Protocol	For selecting the protocol used by port B of the higher-level link service of the Ethernet route. Port number of port B is 12291 ($3003) if TCP/IP or UDP/IP is selected, and port number is 502 ($1F6) if Modbus/TCP (slave) is selected.	0 = TCP/IP 1 = UDP/IP 2 = Modbus/TCP (Slave)	0（TCP/IP）
Higher-Level Link Service: Port B Command Data Format	For selecting the command data format used by port B of the higher-level link service of the Ethernet route. Ignored if Modbus/TCP (slave).	0 = ASCII format 1 = Binary format	1 (Binary format)
Write Protect	Setting to prohibit writing command to this module by the higher-level link service of the Ethernet route.	0 = Writing permitted 1 = Writing not permitted	0 (Writing permitted)

■ Settings Specified as Necessary

Settings specified as necessary for using the Modbus/TCP slave function via Ethernet are as shown below.

Table 2.8.3 Settings Specified as Necessary (Modbus/TCP Slave Function via Ethernet)

Setting Name	Setting Type	Reference for Details*1
Network Filter Settings	CPU Properties	A9.5.8 Network Filter Setup
CPU Operation Restriction	Operation Protection Settings	A.6.22.8 CPU Operation Restriction

*1: Refer to items of "Sequence CPU Instruction Manual - Functions (for F3SP71-4N/4S, F3SP76-7N/7S)" (IM 34M06P15-01E).

● Network Filter Settings

This setting restricts the IP addresses allowed to access this module. The initial value permits all IP addresses to access this module. This setting is referenced from all functions that correspond to higher-level link service functions via Ethernet, such as remote programming service and FTP server.

● CPU Operation Restriction

Use this setting if you want to protect higher-level link services.

CPU operation restriction can be used to protect operating mode switching, log acquisition and other CPU operations that do not use WideField3, depending on the combination of various access routes and CPU operation permission groups.

SEE ALSO

For the CPU operation restriction function (operation protection), refer to "A6.22.8 CPU Operation Restriction" of “Sequence CPU Instruction Manual - Functions (for F3SP71-4N/4S,F3SP76-7N/7S)” (IM 34M06P15-01E).

2.9 Using Modbus/TCP Slave Function via Ethernet

This section describes how to use the Modbus/TCP slave function via Ethernet.

■ Connecting to a Monitor

To connect to a monitor, perform the following steps:

1. Create screen data on a PC.
2. Transfer screen data to a monitor.
3. Match the communication setup of the monitor and the module.
4. Connect the monitor and the module. Begin monitoring.

SEE ALSO

For details on how to connect to the monitor, see the documentation of the monitor.

■ Connecting to a PC

● Connecting to a Program Created on a PC

To connect to a program on a PC, perform the following steps:

1. Create a communication program on a PC (using Visual Basic, etc.)
2. Match the communication setup of the communication program and the module.
3. Connect the communication program and the module. Begin monitoring.

● Connecting to a SCADA Application

To connect to a SCADA application on a PC, perform the following steps:

1. Create screen data on a PC.
2. Match the communication setup of SCADA and the module.
3. Connect SCADA and the module. Begin monitoring.

SEE ALSO

For details on the application (Visual BASIC or SCADA) on the PC end, see the documentation for the application.

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3. Command/Response Details

3.1 Read Coils ($01)

Reads the status (on/off) of a single or multiple coils.

The amount of devices that can be accessed with a single request is 1 to 2,000 points.

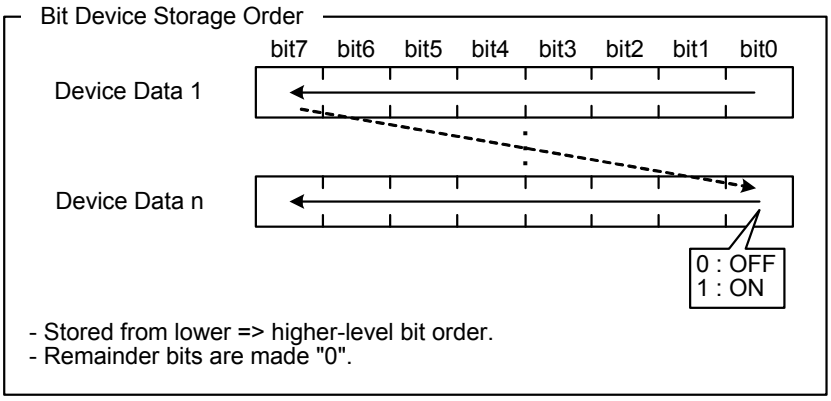
Request Format (Master => Slave)

Function Code	Data	
$01	Starting Coil Nos. ($0000 to $FFFF)	Read Points ($0001 to $07D0)
1-byte	2-byte	2-byte

Response Format (Slave => Master)

(At Normal Completion)

Function Code	Data			
$01	Read Length n ($01 to $FA)	Device Data 1	···	Device Data n
1-byte	1-byte	1-byte		1-byte


Bit Device Storage Order
bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
Device Data 1
Device Data n
0 : OFF
1 : ON
- Stored from lower => higher-level bit order.
- Remainder bits are made "0".

(At Faulty Completion)

Function Code	Data
$81	Error Code
1-byte	1-byte

F030101.VSD

3.2 Read Discrete Inputs ($02)

Reads the status (on/off) of a single or multiple inputs.

The amount of devices that can be accessed with a single request is 1 to 2,000 points.

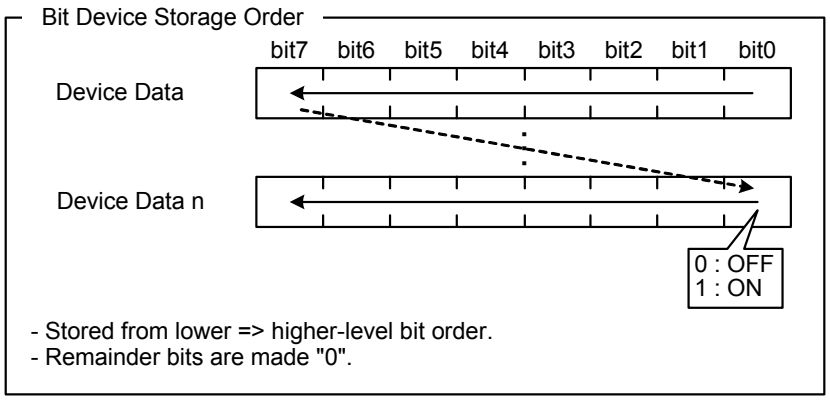
Request Format (Master => Slave)

Function Code	Data	
$02	Starting Input Nos. ($0000 to $FFFF)	Read Points ($0001 to $07D0)
1-byte	2-byte	2-byte

Response Format (Slave => Master)

(At Normal Completion)

Function Code	Data			
$02	Read Length n ($01 to $FA)	Device Data 1	...	Device Data n
1-byte	1-byte	1-byte		1-byte


Bit Device Storage Order
bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
Device Data
Device Data n
0 : OFF
1 : ON
- Stored from lower => higher-level bit order.
- Remainder bits are made "0".

(At Faulty Completion)

Function Code	Data
$82	Error Code
1-byte	1-byte

F030102.VSD

3.3 Read Holding Registers ($03)

Reads the value(s) of a single or multiple holding registers.

The amount of devices that can be accessed with a single request is 1 to 125 points.

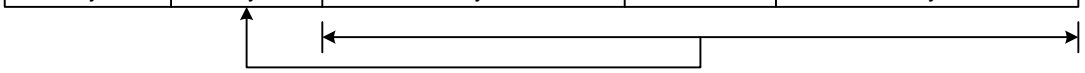
Request Format (Master => Slave)

Function Code	Data	
$03	Starting Holding Register Nos. ($0000 to $FFFF)	Read Points ($0001 to $007D)
1-byte	2-byte	2-byte

Response Format (Slave => Master)

(At Normal Completion)

Function Code	Data			
$03	Read Length nx2 ($02 to $FA)	Device Data 1	...	Device Data n
1-byte	1-byte	2-byte		2-byte



(At Faulty Completion)

Function Code	Data
$83	Error Code
1-byte	1-byte

F030103.VSD

3.4 Read Input Registers ($04)

Reads the value(s) of a single or multiple input registers.

The amount of devices that can be accessed with a single request is 1 to 125 points.

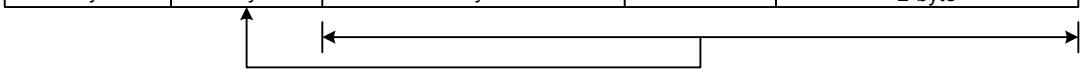
Request Format (Master => Slave)

Function Code	Data	
$04	Starting Input Register Nos. ($0000 to $FFFF)	Read Points ($0001 to $007D)
1-byte	2-byte	2-byte

Response Format (Slave => Master)

(At Normal Completion)

Function Code	Data			
$04	Read Length nx2 ($02 to $FA)	Device Data 1	...	Device Data n
1-byte	1-byte	2-byte		2-byte



(At Faulty Completion)

Function Code	Data
$84	Error Code
1-byte	1-byte

F030104.VSD

3.5 Write Single Coil ($05)

Writes the value (either 1 or 0) to a single coil.

The amount of devices that can be accessed with a single request is one point.

Request Format (Master => Slave)

Function Code	Data	
$05	Coil Nos. ($0000 to $FFFF)	Specified Value 1:$FF00 0:$0000
1-byte	2-byte	2-byte

Response Format (Slave => Master)

(At Normal Completion)

Function Code	Data	
$05	Coil Nos. (Same Value as Request)	Specified Value (Same Value as Request)
1-byte	2-byte	2-byte

The slave returns the request received from the master with no change.

(At Faulty Completion)

Function Code	Data
$85	Error Code
1-byte	1-byte

F030105.VSD

3.6 Write Single Register ($06)

Writes the value to a single holding register.

The amount of devices that can be accessed with a single request is one point.

Request Format (Master => Slave)

Function Code	Data	
$06	Holding Register Nos. ($0000 to $FFFF)	Write Points ($0000 to $FFFF)
1-byte	2-byte	2-byte

Response Format (Slave => Master)

(At Normal Completion)

Function Code	Data	
$06	Holding Register Nos. (Same Value as Request)	Write Points (Same Value as Request)
1-byte	2-byte	2-byte

The slave returns the request received from the master with no change.

(At Faulty Completion)

Function Code	Data
$86	Error Code
1-byte	1-byte

F030106.VSD

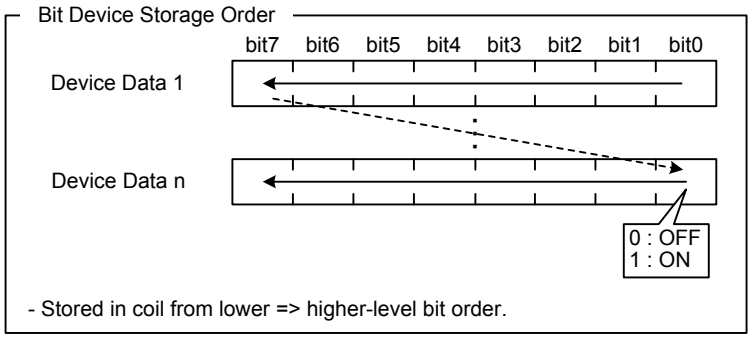
3.7 Write Multiple Coils ($0F)

Writes the value (either 1 or 0) to multiple coils.

The amount of devices that can be accessed with a single request is 1,968 points.

Request Format (Master => Slave)

Function Code	Data					
$0F	Starting Coil Nos. ($0000 to $FFFF)	Write Points ($0001 to $07B0)	Write Length n ($01 to $F6)	Device Data	...	Device Data n
1-byte	2-byte	2-byte	1-byte	1-byte		1-byte


Bit Device Storage Order
bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
Device Data 1
Device Data n
0 : OFF
1 : ON
- Stored in coil from lower => higher-level bit order.

Response Format (Slave => Master)

(At Normal Completion)

Function Code	Data	
$0F	Starting Coil Nos. (Same Value as Request)	Write Points (Same Value as Request)
1-byte	2-byte	2-byte

(At Faulty Completion)

Function Code	Data
$8F	Error Code
1-byte	1-byte

F030107.VSD

CAUTION

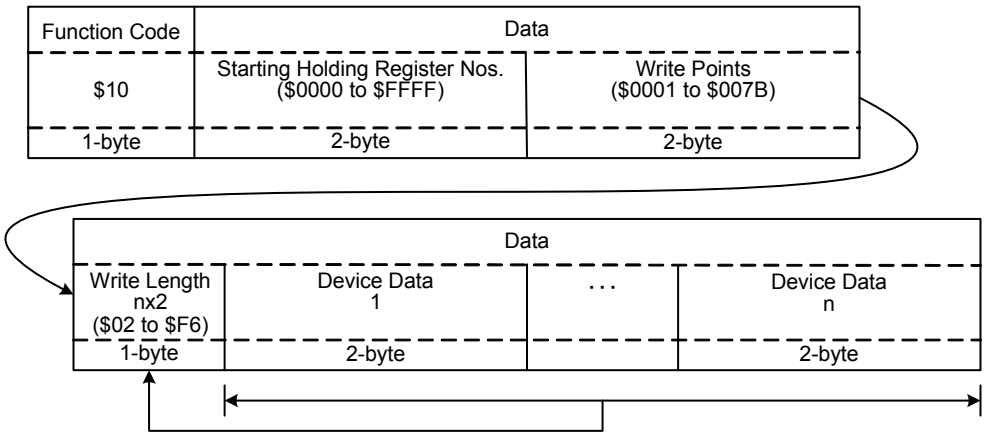
Writing is performed by dividing into multiple scans if the write points are 16 m (multiples of 16).

3.8 Write Multiple Registers ($10)

Writes the values to multiple holding registers.

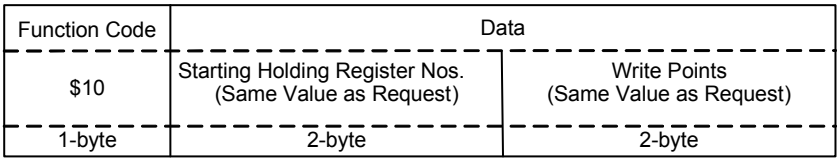
The amount of devices that can be accessed with a single request is 1 to 123 points.

Request Format (Master => Slave)

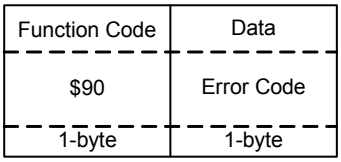


Response Format (Slave => Master)

(At Normal Completion)



(At Faulty Completion)



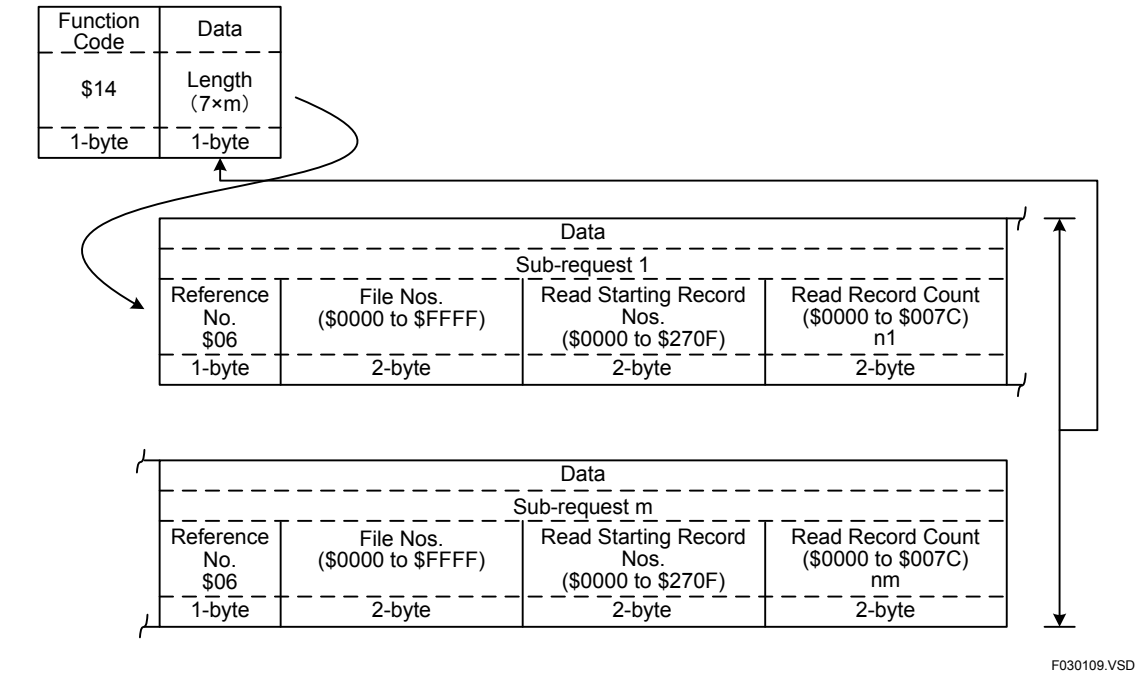
F030108.VSD

3.9 Read File Record ($14)

Reads the values of multiple file records.

The amount of devices that can be accessed with a single request is 1 to 124 points.

Request Format (Master => Slave)

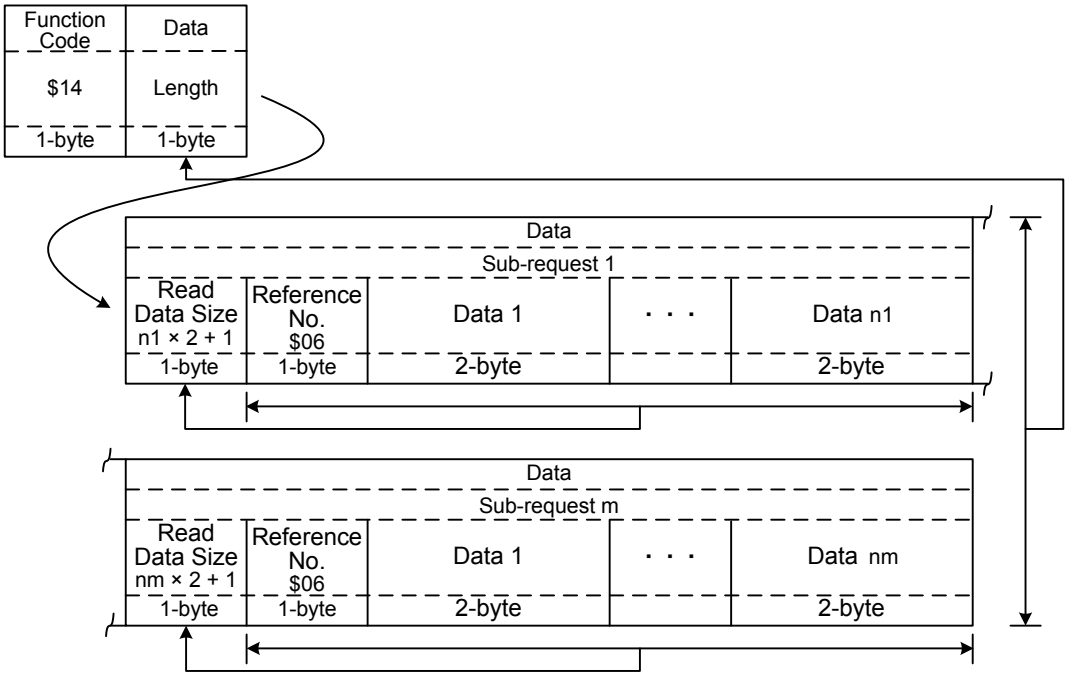


(a) Specify the sub-request count m so that the request PDU (protocol data units) size does not exceed 253 bytes ($m \leq 35$).

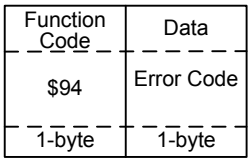
(b) Specify the total read points N (n1 + ... + nm) of each sub-request so that the response PDU (protocol data units) size does not exceed 253 bytes.

Response Format (Slave => Master)

(At Normal Completion)



(At Faulty Completion)



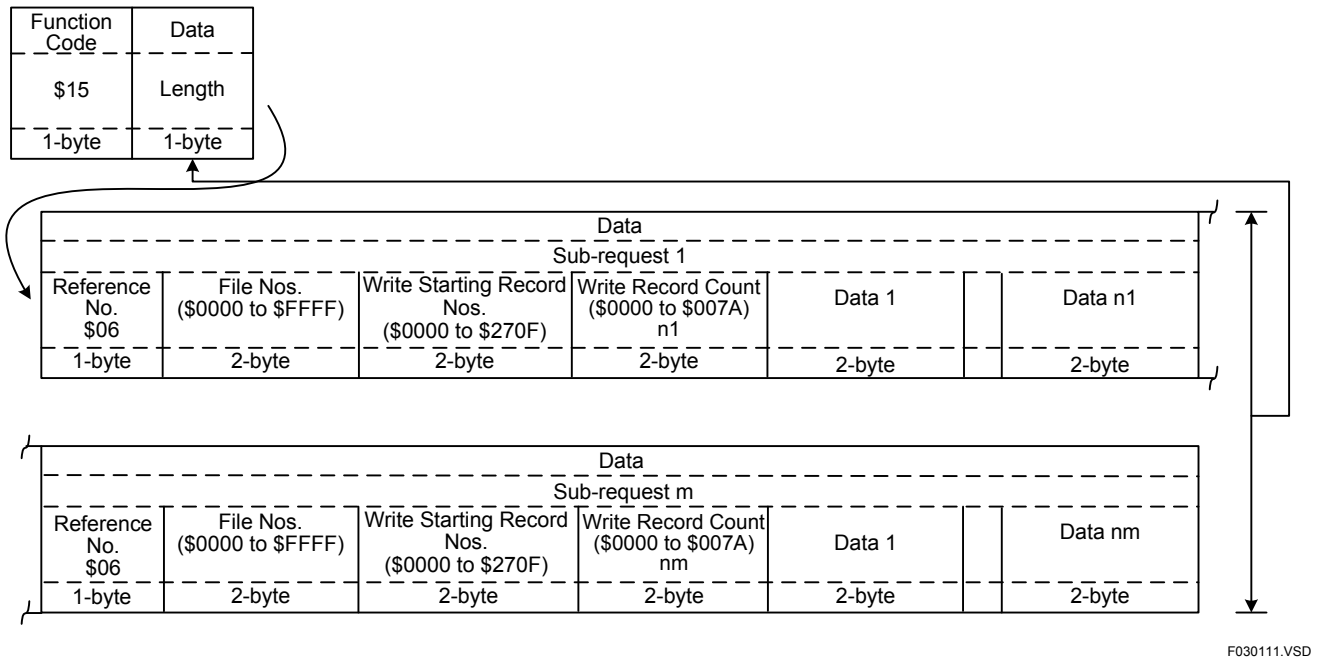
F030110.VSD

3.10 Write File Record ($15)

Writes the values to multiple file records.

The amount of devices that can be accessed with a single request is 1 to 122 points.

Request Format (Master => Slave)

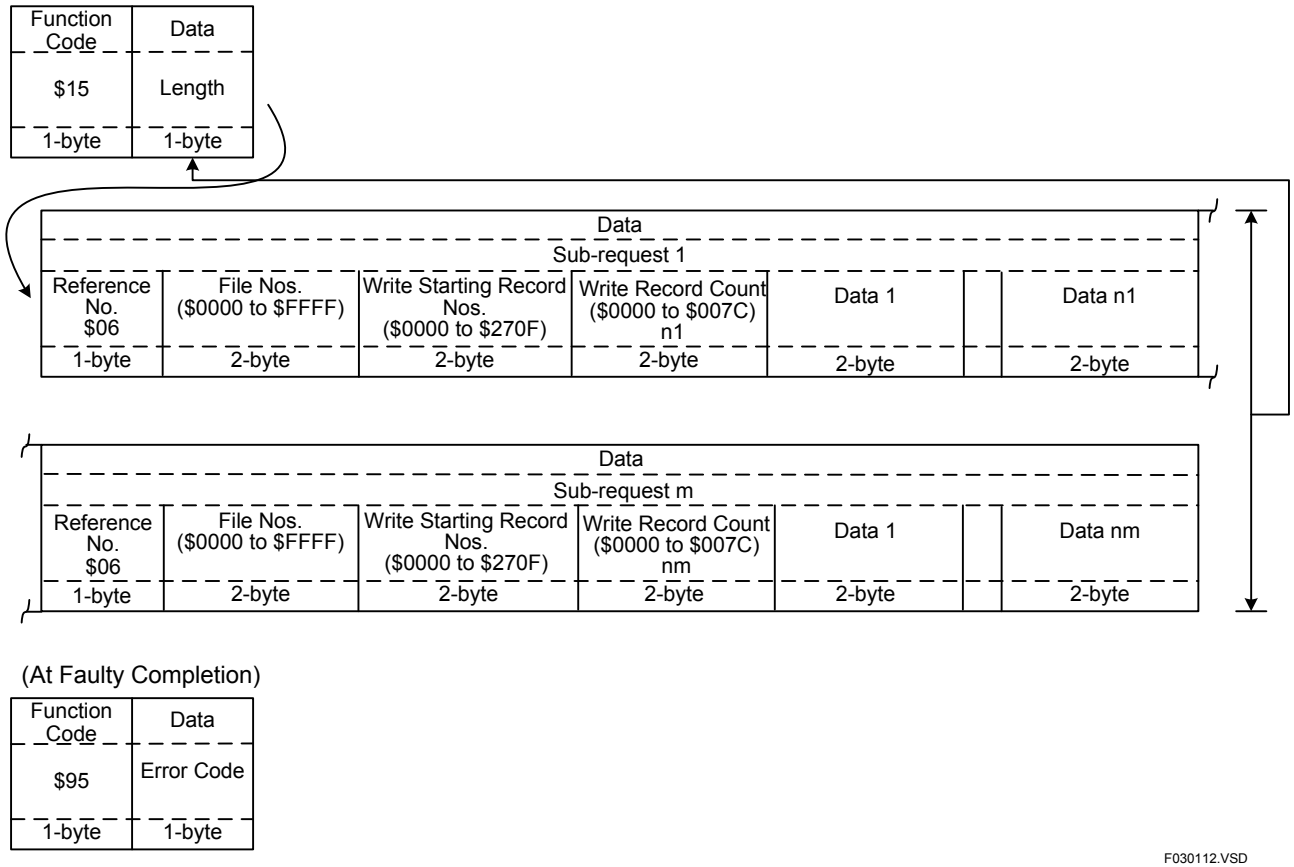


F030111.VSD

(a) Specify the total read points N (n1 + ... + nm) of each sub-request so that the response PDU (protocol data units) size does not exceed 253 bytes.

Response Format (Slave => Master)

(At Normal Completion)



(At Faulty Completion)

Function Code	Data
$95	Error Code
1-byte	1-byte

F030112.VSD

3.11 Mask Write Register ($16)

Masks the value stored in a single holding register using AND or OR, and writes the value.

The amount of devices that can be accessed with a single request is one point.

The value written into a holding register is as described below.

Written value = (Current value & AND mask value) | (OR mask value & ˜AND mask value)

If the OR mask value is $0000, only AND processing of the AND mask value is performed.

If the AND mask value is $0000, the OR mask value is the written value.

Response Format (Slave => Master)

Function Code	Data		
$16	Starting Register Nos. ($0000 to $FFFF)	AND Mask Value ($0000 to $FFFF)	OR Mask Value ($0000 to $FFFF)
1-byte	2-byte	2-byte	2-byte

Response Format (Master => Slave)

(At Normal Completion)

Function Code	Data		
$16	Starting Register Nos. ($0000 to $FFFF)	AND Mask Value ($0000 to $FFFF)	OR Mask Value ($0000 to $FFFF)
1-byte	2-byte	2-byte	2-byte

(At Faulty Completion)

Function Code	Data
$96	Error Code
1-byte	1-byte

F030113.VSD

Tip

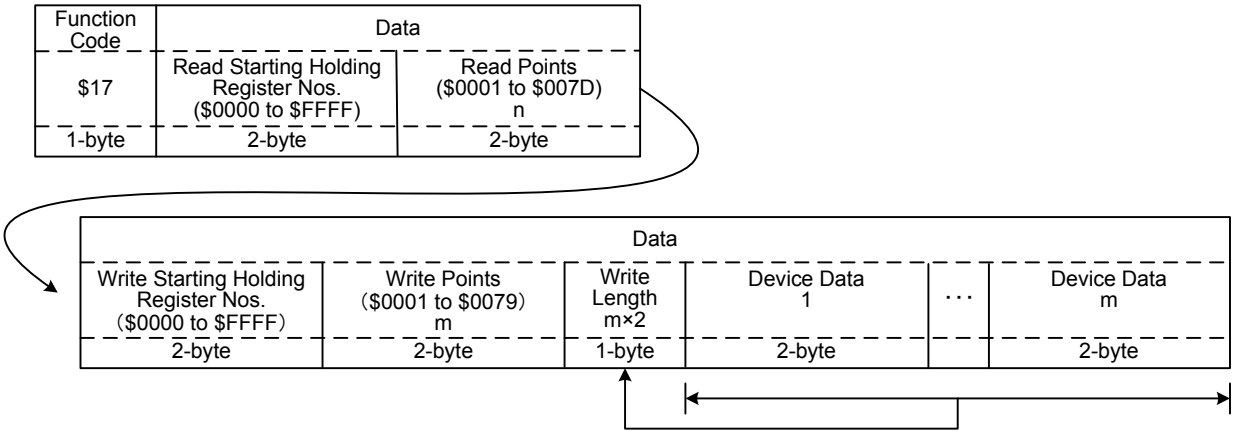
This function reads the value stored in the holding register from the slave, performs AND/OR processing, and then writes the value in the storage register. Accordingly, if the holding register value changes during AND/OR processing, the changed value is overwritten.

3.12 Read/Write Multiple Registers ($17)

Reads and writes multiple holding registers. Processing consists of writing followed by reading.

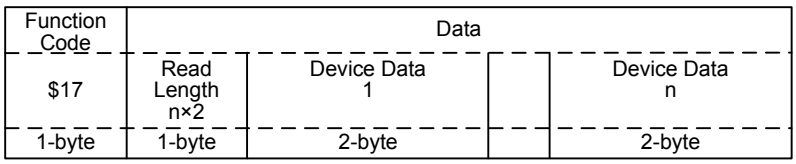
The amount of devices that can be accessed with a single request is 1 to 125 points for reading and 1 to 121 points for writing.

Request Format (Master => Slave)

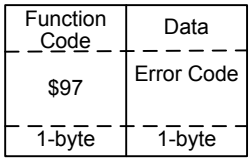


Response Format (Slave => Master)

(At Normal Completion)



(At Faulty Completion)



F030114.VSD

CAUTION

Writing and reading processes are performed using separate scans.

3.13 Read FIFO Queue ($18)

Reads the value(s) of a single or multiple holding registers.

The amount of devices that can be accessed with a single request is 1 to 31 points.

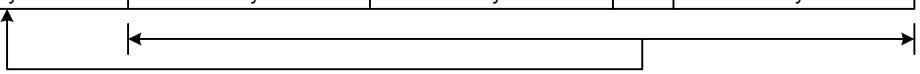
Request Format (Master => Slave)

Function Code	Data
$18	FIFO Pointer Nos. ($0000 to $FFFF)
1-byte	2-byte

Response Format (Slave => Master)

(At Normal Completion)

Function Code	Data				
$18	Length ($0002 to $0040)	FIFO Count ($0000 to $001F)	Device Data 1	···	Device Data n
1-byte	2-byte	2-byte	2-byte		2-byte



(At Faulty Completion)

Function Code	Data
$98	Error Code
1-byte	1-byte

F030115.VSD

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Revision Information

Document Name: Sequence CPU - Modbus/TCP Functions
Document No. : IM 34M06P15-03E

Edition	Date	Revised Item
1st	June 2011	New publication
2nd	Jan. 2012	Errata

Written by PLC Group
International Sales Promotion Dept.
IA Systems Business Headquarters
Yokogawa Electric Corporation
Published by Yokogawa Electric Corporation
2-9-32 Nakacho, Musashino-shi, Tokyo, 180-8750, JAPAN
Printed by Kohoku Publishing & Printing Inc.

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